Reinforcing Networking Concepts—A Modular Approach

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Abstract

The cost of providing hands-on environments for reinforcing specialized computer concepts forces many educational institutions to prioritize the courses and topics that get computer lab support and specialized topics tend to be at the bottom of the list. A modular solution to this problem provides a dynamic environment that can be used for reinforcing networking concepts and evolves over time, as funding is made available.

Keywords: Networking, computer labs, modular lab configuration

1. INTRODUCTION

One of the significant challenges facing computer departments today is providing computer lab facilities that match the ever-changing computer discipline. Computer lab facilities that support advanced computing topics tend to be narrowly focused on one or two specialized subject areas and are not configurable for other purposes. Space for new computer labs is at a premium and is nonexistent at most educational institutions. Outfitting an advanced computer lab to provide support for an entire class of students is likewise difficult due to funding limitations. The amount of computer lab support available for courses tends to be a function of their frequency, making it difficult for upper division courses to compete. The long-term outlook for this problem is bleak as the number of computer topics and student demand for hands-on reinforcement increases. Survivability as a computer department may well depend on solving this problem.

2. ONE ANSWER – DYNAMIC LABS USING A MODULAR CONFIGURATION

A novel approach to the problem is proposed that provides a dynamically configurable computer lab that can be adapted to the requirements of a computer course in a matter of minutes. This concept uses a modular configuration of equipment that requires relatively small funding increments and permits a computer lab to evolve in size as funding becomes available.
The precise configuration of a module depends on the purposes that it is used for, but the basic configuration is shown in Figure 1.

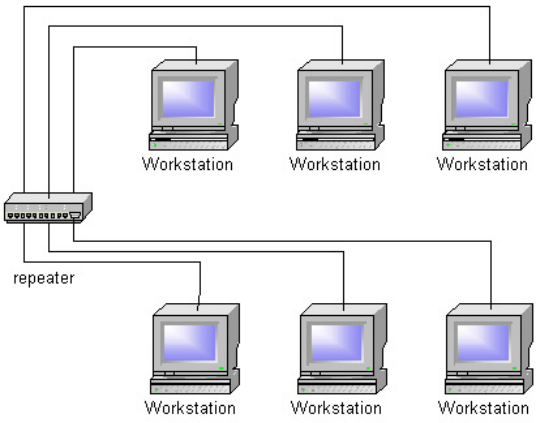

Figure 1

This configuration shows three computers in two different rows connected to a repeater. Note that two computers could be used in each row if three aren't

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available. Specifications for the computers will be discussed below. Three computers are proposed in each row for maximum flexibility in the use of a module. One important advantage of this proposed lab is that it does not require or depend on any networking support outside of the physical room. The lab is completely self-contained in terms of networking, requiring only simple cabling between devices. Because it is self-contained, a module can be placed in a classroom. Whether in a computer lab or classroom, students are free to experiment without interfering with any production network environment.

3. REINFORCING NETWORKING CONCEPTS IN A DYNAMIC LAB

Figure 2 depicts a simple network that can be used to experiment with simple file server administration tasks such as creating users accounts, sharing resources, and group accounts.

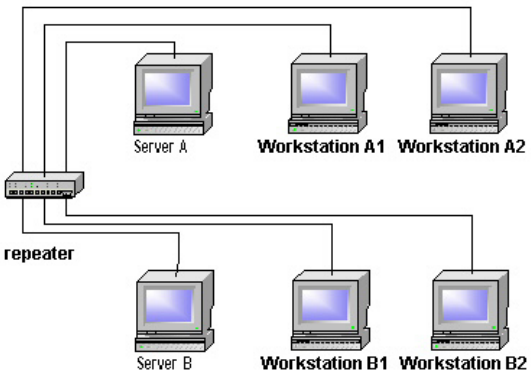

Figure 2

Students working in groups of three begin by installing the network operating system software on the server assigned to their group. Two groups are supported by one module. Next, user accounts are created on the server. Once the user accounts are in place, user-level shared folders could be created on the server. Students using workstations could log in as different users and learn to access those folders, reinforcing the access privilege concepts associated with shares. File and folder permissions could be set on server folders to simulate different scenarios and workstation exercises could validate the security of the server by restricting access according to the permissions that were set. Creating group accounts would extend the exercises and combinations of group and user permissions could be tested. An additional extension would come from demonstrating the effects of combining share permissions with user-level permissions on a server. System policies could also be exercised with this module configuration.

Modification of this module configuration could lead to the enterprise networking configuration depicted in Figure 3.

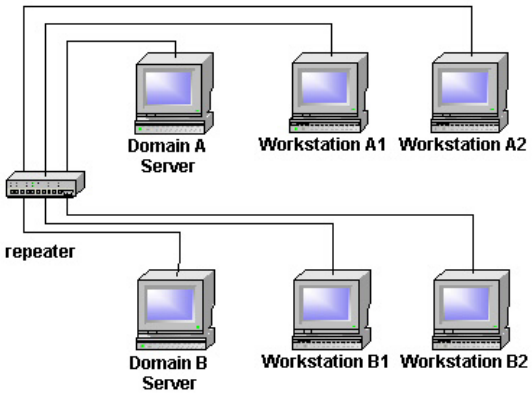

Figure 3

With this configuration, students could learn about workgroups, domains, trusted domains, primary domain controllers, and secondary domain controllers. The limitations of access privileges in workgroups could be explored. Scenarios requiring combinations of one-way and two-way trusts could be simulated along with shared folders. Exercises could validate the students' intuition about how the trust concept enforces security in an enterprise network environment.

Network printing exercises could be performed using the configuration in either Figure 2 or Figure 3, with the addition of a printer. Students could set up and share a network printer or workstation printer. Printer scheduling and management exercises could be conducted with minimal setup.

Network applications involving server products such as ClipBook, Workgroup Postoffice, Messaging Client, Chat, Dynamic Host Configuration Protocol (DHCP), Windows Internet Naming Service (WINS), and Domain Name Server (DNS) could be installed, configured, and tested using the modular approach.

Students could perform system monitoring functions, such as monitoring server services, logged on users, server access, and event logs. Server diagnostic tools could be used to troubleshoot simulated server and network problems. Server backup, restore, and fault tolerance concepts could also be explored.

4. EQUIPMENT REQUIREMENTS

One benefit of this concept is that equipment requirements can be kept to a minimum and use of modules can expand as equipment is added to them. Computers that are being taken out of service as desktop computers can serve as workstations in most of the modules presented here. Even computers targeted as file servers can be minimally equipped because of the nature of their use in conducting experiments. If a computer can run a network operating system at all, it can function in some capacity for experimentation purposes in one or more of these modules.

The key to the flexibility of the computers to serve multiple purposes lies in the use of hard drive shuttle bays. These bays allow the computer to be changed from one configuration, e.g., a workstation, to another, e.g., a primary domain controller, in a matter of minutes. Any computer in a module can change identity in a minute by swapping out the shuttle and rebooting the machine. These shuttle bays provide a truly dynamic environment for computer experimentation.

5. DIRECTIONS FOR FURTHER RESEARCH

The next phase of this work will involve detailing actual experiments that can be performed using the various network configurations proposed. Each of the module uses described in this paper will be analyzed and molded into a set of exercises supporting a semester-long course. The exercises will be tried in actual course settings and feedback obtained from the students and faculty involved.

The long-term for this project will involve identifying other areas of computing that this modular approach is suited for. As each topic area is identified, sets of exercises will be developed supporting them.

6. CONCLUSION

Computer lab facilities for specialized areas of computing such as those described in this paper are hard to find in educational institutions. Meaningful exercises that reinforce networking concepts can make the difference between an ordinary course and one that students are eager to take on. The dynamic, modular computer lab concept proposed in this paper addresses both of these issues and integrates them into an environment that adds a whole new dimension to the learning experience for computing students. The concept is robust and will evolve as new technologies are developed and make their way into computing curricula.

7. REFERENCES

Forouzan, Behroutz A., *Data Communications and Networking*, 2nd Edition, 2001, McGraw-Hill, New York

Palmer, Michael J., *Hands-on Microsoft Windows NT 4.0 Server*, 1997, Course Technology, Cambridge, MA

Palmer & Sinclair, *A Guide to Designing and Implementing Local and Wide Area Networks*, 1999, Course Technology, Cambridge, MA

Tanenbaum, Andrew S., *Computer Networks*, Third Edition, 1996, Prentice-Hall, New Jersey